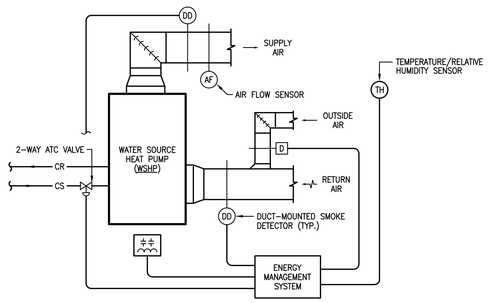


WATER SOURCE HEAT PUMP CONTROL SEQUENCE

(1) OCCUPIED/UNOCCUPIED CONTROL SHALL BE DETERMINED BY THE EMS. WHEN IN THE OCCUPIED MODE, THE SUPPLY FAN SHALL RUN CONTINUOUSLY. WHEN IN THE UNOCCUPIED MODE, THE SUPPLY FAN SHALL RUN DE-ACTIVATED.

(2) ON A DROP IN SPACE TEMPERATURE BELOW THE HEATING SET POINT OF TEMPERATURE/ RELATIVE HUMIDITY SENSOR, TH, THE HEATING CYCLE SHALL BE ENERGIZED AFTER SLOW CLOSING/OPENING TWO-WAY ATC VALVE OPENS.

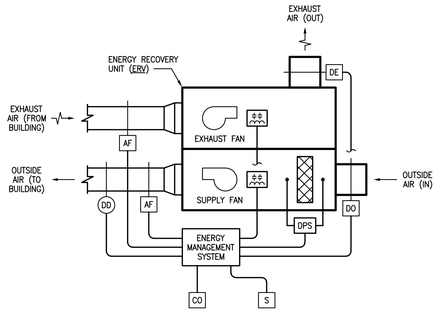
(3) ON A RISE IN SPACE TEMPERATURE ABOVE THE COOLING SET POINT OF TH, THE COOLING CYCLE SHALL BE ENERGIZED AFTER SLOW CLOSING/OPENING TWO-WAY ATC VALVE OPENS.

(4) ON A RISE IN SPACE RELATIVE HUMIDITY, AS SENSED BY TH, THE DEHUMIDIFICATION CYCLE (WITH REFRIGERANT REHEAT) SHALL BE ENERGIZED. CONTROL SETPOINT SHALL BE 45% RH.

(5) DUCT SMOKE DETECTOR, DD, SHALL STOP THE FAN AND CLOSE OUTSIDE AIR DAMPER, D, UPON SENSING IMPROPER CONDITIONS.

(6) IF AIR FLOW SENSOR, AF, SENSES NO FLOW FROM SUPPLY FAN, AN ALARM SHALL BE REGISTERED AT THE EMS.

(7) DURING MORNING WARM-UP, THE SUPLY FAN SHALL BE ENERGIZED, THE OUTSIDE AIR DAMPER, D, SHALL BE CLOSED, THE TWO-WAY ATC VALVE SHALL OPEN AND THE HEATING CYCLE SHALL BE ENERGIZED.



ENERGY RECOVERY UNIT CONTROL (ERV-1)

(1) OCCUPIED/UNOCCUPIED MODE SHALL BE DETERMINED BY A WALL MOUNTED, PUSH-BUTTON SWITCH (S). SWITCH SHALL BE PROVIDED WITH A TIME DELAY AND SEND THE ERV INTO OCCUPIED MODE FOR A MIN. 2 HOUR INTERVAL. AFTER 2 HOURS, ERV SHALL AUTOMATICALLY DE-ENERGIZE INTO UNOCCUPIED MODE.

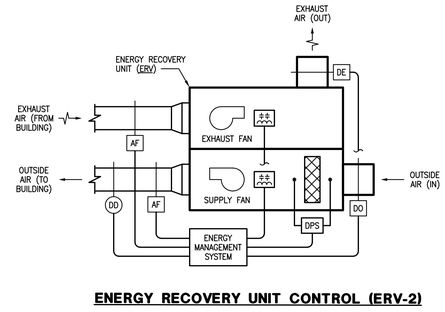
(2) **WHEN IN THE OCCUPIED MODE:**
UNIT SUPPLY AND EXHAUST FANS SHALL RUN CONTINUOUSLY. OUTSIDE AIR DAMPER, DO, AND EXHAUST AIR DAMPER, DE, SHALL BE OPEN. THE UNIT SHALL OPERATE ON ITS BUILT-IN CONTROLS FOR HEAT TRANSFER BETWEEN THE EXHAUST AIR AND SUPPLY AIR STREAMS.

(3) **WHEN IN THE UNOCCUPIED MODE:**
UNIT SUPPLY AND EXHAUST FANS SHALL BE OFF. OUTSIDE AIR DAMPER, DO, AND EXHAUST AIR DAMPER, DE, SHALL BE CLOSED.

(4) **DUCT SMOKE DETECTOR:**
DUCT SMOKE DETECTOR (FURNISHED BY DIVISION 16, INSTALLED BY DIVISION 15), DD, LOCATED IN THE OUTSIDE AIR DISCHARGE DUCT, SHALL SEND A SIGNAL TO THE FIRE ALARM SYSTEM UPON SENSING IMPROPER CONDITIONS. THE FIRE ALARM SYSTEM SHALL SEND A SIGNAL TO THE EMS TO TURN OFF THE SUPPLY FAN, TURN OFF THE EXHAUST FAN AND CLOSE THE DAMPERS (DO & DE).

(5) **FLOW SENSORS:**
IF DUCT-MOUNTED AIR FLOW SENSOR, AF, SENSES NO FLOW FROM ITS ASSOCIATED SUPPLY FAN, AN ALARM SHALL BE REGISTERED AT THE EMS.

(6) **CARBON MONOXIDE SENSOR:**
ERV SHALL BE INTERLOCKED WITH CARBON MONOXIDE (CO) SENSOR. IF UNSAFE OSHA LEVELS OF CO ARE SENSED, ERV SHALL BE ENERGIZED UNTIL SAFE LEVEL IS ACHIEVED.



ENERGY RECOVERY UNIT CONTROL (ERV-2)

(1) OCCUPIED/UNOCCUPIED MODE SHALL BE DETERMINED BY THE ENERGY MANAGEMENT SYSTEM, EMS.

(2) **WHEN IN THE OCCUPIED MODE:**
UNIT SUPPLY AND EXHAUST FANS SHALL RUN CONTINUOUSLY. OUTSIDE AIR DAMPER, DO, AND EXHAUST AIR DAMPER, DE, SHALL BE OPEN. THE UNIT SHALL OPERATE ON ITS BUILT-IN CONTROLS FOR HEAT TRANSFER BETWEEN THE EXHAUST AIR AND SUPPLY AIR STREAMS.

(3) **WHEN IN THE UNOCCUPIED MODE:**
UNIT SUPPLY AND EXHAUST FANS SHALL BE OFF. OUTSIDE AIR DAMPER, DO, AND EXHAUST AIR DAMPER, DE, SHALL BE CLOSED.

(4) **DUCT SMOKE DETECTOR:**
DUCT SMOKE DETECTOR (FURNISHED BY DIVISION 16, INSTALLED BY DIVISION 15), DD, LOCATED IN THE OUTSIDE AIR DISCHARGE DUCT, SHALL SEND A SIGNAL TO THE FIRE ALARM SYSTEM UPON SENSING IMPROPER CONDITIONS. THE FIRE ALARM SYSTEM SHALL SEND A SIGNAL TO THE EMS TO TURN OFF THE SUPPLY FAN, TURN OFF THE EXHAUST FAN AND CLOSE THE DAMPERS (DO & DE).

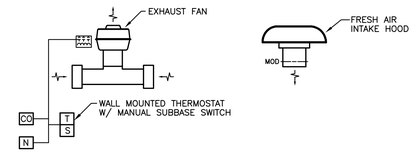
(5) **FLOW SENSORS:**
IF DUCT-MOUNTED AIR FLOW SENSOR, AF, SENSES NO FLOW FROM ITS ASSOCIATED SUPPLY FAN, AN ALARM SHALL BE REGISTERED AT THE EMS.

THE ENERGY MANAGEMENT SYSTEM SHALL DETERMINE THE OCCUPIED-UNOCCUPIED MODE. SYSTEM SHALL ALSO PROVIDE THE FUNCTIONS INDICATED IN THE SPECIFICATION. EACH INDIVIDUAL SYSTEM SHALL HAVE ITS OWN INDEPENDENT OPERATING SCHEDULE.

THE FOLLOWING POINTS SHALL BE MONITORED BY THE EMS SYSTEM:

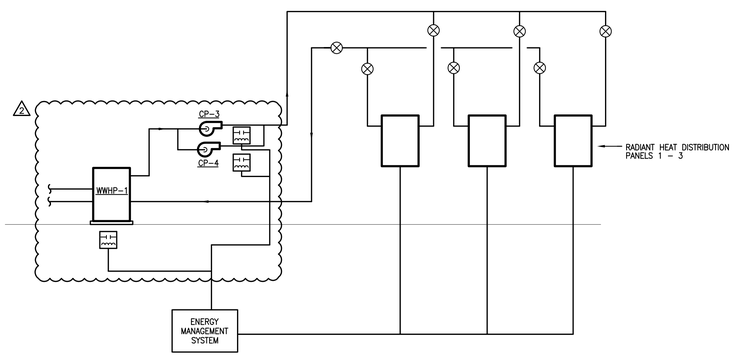
1) CONDENSER WATER SUPPLY AND RETURN TEMPERATURE
2) CONDENSER WATER SYSTEM PUMP STATUS
3) CONDENSER WATER PUMP VARIABLE FREQUENCY DRIVE OPERATING %
4) HEATING WATER SYSTEM SUPPLY AND RETURN TEMPERATURE
5) HEATING WATER SYSTEM PUMP STATUS
6) WATER SOURCE HEAT PUMP STATUS
7) ENERGY RECOVERY VENTILATOR STATUS
8) EXHAUST FAN STATUS
9) ZONE TEMPERATURES IN EACH ZONE
10) OUTDOOR AIR DRY BULB AND WET BULB TEMPERATURE

ENERGY MANAGEMENT SYSTEM



EXHAUST FAN CONTROL - APPARATUS BAYS (EF-1)

1. WHEN THE SPACE TEMPERATURE, AS SENSED BY THERMOSTAT, T, RISES ABOVE THE ADJUSTABLE SETPOINT, (78°F, ADJ.) INTAKE AIR MOTOR OPERATED DAMPER SHALL OPEN, THE FAN SHALL RUN AFTER ALL END SWITCHES HAVE PROVEN OPEN.
2. WHEN THE MANUAL SUBBASE SWITCH, S, IS SET TO THE ON POSITION, INTAKE AIR MOTOR OPERATED DAMPER SHALL OPEN, THE FAN SHALL RUN AFTER ALL END SWITCHES HAVE PROVEN OPEN.
3. EXHAUST FAN SHALL BE INTERLOCKED WITH THE CO AND N (NITROGEN) SENSORS, THERMOSTATS (W/MANUAL SUB-BASESWITCH) AND MOTOR OPERATED DAMPER ON INTAKE HOOD. CO & N SENSORS SHALL OVERRIDE THERMOSTAT & SWITCH UPON SENSING UNSAFE OSHA RECOMMENDED CONDITIONS.



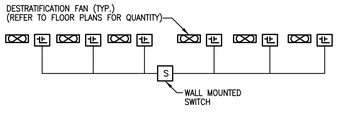
RADIANT FLOORHEATING CONTROLS

OCCUPIED-UNOCCUPIED CONTROL SHALL BE DETERMINED BY THE EMS. INITIALLY, THE SYSTEM SHALL BE IN THE OCCUPIED MODE 365 DAYS PER YEAR, 24 HOURS PER DAY.

UPON A CALL FOR HEATING FROM ONE OF THE RADIANT FLOOR HEATING ZONES:

(1) THE ASSOCIATED CIRCULATING PUMP (CP-3 OR CP-4) SHALL BE ENERGIZED. IF THE LEAD PUMPS FAILS TO OPERATE, AS SENSED BY DIFFERENTIAL PRESSURE SENSOR, THE LAG PUMP SHALL BE ENERGIZED. THE LEAD PUMP SHALL BE ALTERNATED ON SUCCESSIVE STARTS.

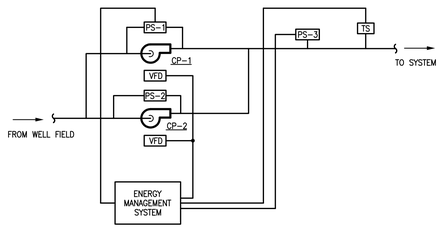
(2) THE WWHP SHALL BE ENERGIZED TO MAINTAIN THE HEATING WATER SET POINT (INITIALLY SET AT 110 DEGREES F)



1. WHEN THE SWITCH, S, IS SET TO THE ON POSITION, THE FANS SHALL RUN.
2. APARATUS BAY CEILING FANS SHALL BE INTERLOCKED TO OPERATE VIA (1) WALL MOUNTED SWITCH.

DESTRATIFICATION CEILING FAN CONTROL

SCALE: NONE

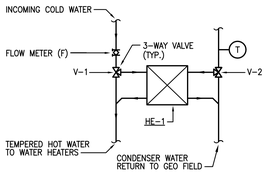


CONDENSER WATER SYSTEM CONTROL

(1) OCCUPIED-UNOCCUPIED CONTROL SHALL BE DETERMINED BY THE ENERGY MANAGEMENT SYSTEM (EMS). THE CONDENSER WATER LOOP SHALL BE IN THE OCCUPIED MODE 365 DAYS PER YEAR FOR 24 HOURS PER DAY.

(2) WHEN IN THE OCCUPIED MODE, THE LEAD CONDENSER WATER PUMP SHALL OPERATE CONTINUOUSLY. THE SPEED OF THE PUMP SHALL BE CONTROLLED BY THE VARIABLE FREQUENCY DRIVE (VFD), TO PROVIDE THE REQUIRED SYSTEM PRESSURE, AS SENSED BY DISCHARGE PIPE PRESSURE SENSOR, PS-3.

(3) IF THE LEAD PUMP FAILS TO OPERATE, AS SENSED BY DIFFERENTIAL PRESSURE SENSOR, PS-1 OR PS-2, THE STANDBY PUMP SHALL BE ENERGIZED. THE LEAD PUMP SHALL BE ALTERNATED ON A MONTHLY BASIS.



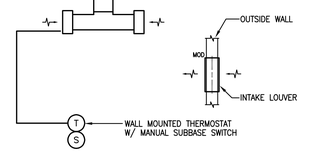
HEAT EXCHANGER CONTROL (HE-1)

THE HEAT EXCHANGER SHALL BE ENERGIZED AND VALVES V-1 AND V-2 (SERVING CONDENSER WATER RETURN AND INCOMING COLD WATER) SHALL MODULATE TO SEND FLOW THROUGHT THE HEAT EXCHANGER UPON SATISFYING THE FOLLOWING CONDITIONS:

1) THE CONDENSER RETURN WATER REACHES MINIMUM SETPOINT TEMPERATURE (75° ADJ.) AS SENSED BY THERMOMETER, T.

2) THERE IS A DEMAND FOR HOT WATER AS SENSED BY FLOW METER, F.

WHEN BOTH CONDITIONS ARE NO LONGER SATISFIED, VALVES V-1 AND V-2 SHALL MODULATE TO BYPASS HEAT EXCHANGER.

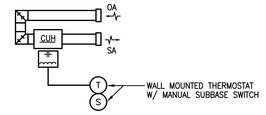


EXHAUST FAN CONTROL (EF-2)

1. MANUAL SUBBASE SWITCH SHALL BE "ON-OFF-AUTO"
2. WHEN SET TO THE "ON" POSITION, INTAKE AIR MOTOR OPERATED DAMPER SHALL OPEN AND FAN SHALL ENERGIZE.
3. WHEN SET TO THE "OFF" POSITION, INTAKE AIR MOTOR OPERATED DAMPER SHALL CLOSE AND FAN SHALL DE-ENERGIZE.
4. WHEN SET TO THE "AUTO" POSITION, FAN SHALL BE CONTROLLED TO OPERATE BY SET POINT TEMPERATURE AS DESCRIBED BELOW:

   UPON A RISE IN THE SPACE TEMPERATURE ABOVE SETPOINT OF 78°F (ADJ.) AS SENSED BY WALL MOUNTED THERMOSTAT, T, INTAKE AIR MOTOR OPERATED DAMPER SHALL OPEN AND FAN SHALL ENERGIZE. UPON SATISFYING TEMPERATURE SETPOINT, FAN SHALL DE-ENERGIZE AND INTAKE AIR MOTOR OPERATED DAMPER SHALL CLOSE.

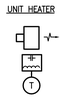
NOTE:
EF-2 AND CUH-1 SHARE THE SAME WALL MOUNTED SPACE THERMOSTAT, T.



CABINET UNIT HEATER CONTROL (CUH-1)

UPON A DROP IN SPACE TEMPERATURE BELOW THE SETPOINT OF THERMOSTAT, T, (65° ADJUSTABLE) UNIT HEATER SHALL ENERGIZE. UNIT HEATER SHALL NOT BE LINKED TO SUBBASE SWITCH, S, AND SHALL OPERATE FOR ALL SETTINGS OF SWITCH.

NOTE:
EF-2 AND CUH-1 SHARE THE SAME WALL MOUNTED SPACE THERMOSTAT, T.



ELECTRIC UNIT HEATER CONTROL

ALL ELECTRIC HEATERS ARE TO BE PROVIDED WITH INTEGRAL THERMOSTATS. UPON A DROP IN SPACE TEMPERATURE BELOW THE SET POINT OF THERMOSTAT, T, (65°F, ADJUSTABLE) UNIT HEATER SHALL ENERGIZE.

No.	Description	Date	App.
	REVIEW SET	06/04/10	
	85% SUBMISSION	06/17/10	
	95% SUBMISSION	07/16/10	
	BID SET	07/30/10	
	100% SUBMISSION	08/27/10	
	ISSUED FOR PERMIT	09/15/10	
	CLIENT BID REVIEW SET	01/19/11	
	CLIENT REVIEW SET	03/02/11	
	BID SET	03/17/11	

Drawn: TB/SPA
Checked: SPA
Approved: SPA
Issued: 03/17/11

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Sheet Contents: **ATC DIAGRAMS**

Scale: AS SHOWN

Dwg. No. **M8.1**

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